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Sanitized Copy Approved for Release 2011/04/08 : CIA-RDP81-00280R000200030036-4

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FORMATION OF SUPPLEMENTARY CHANNELS

Vestnik Svyazi /Communication News/, No 6, 1953, Moscow, Pages 27-28

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Shift Engineer K. V. Lisunov of the Ufim Interurban Telephone Station has suggested a circuit, which permits forming a telephone channel within the spectrum of a photographic channel that is not being used for its intended purpose. The action of the channel produced (Figure 1) is based on the principle of operation of duplex-low frequency telephone amplifiers of the STDU-35 type, but with the tonal frequencies being converted into frequencies of the photo-channel spectrum (transmission and reception are carried out at the same frequency). In the given case the modulation and demodulation of the speech frequencies is effected at a frequency of 5.4 kc obtained from the generators of the OKS racks of both terminal stations.

This communication is effected by using a spare STDU-35 amplifier. Connected in the transmission channel past the balance modulator M, which is of the ring type, is filter D-5.5, which replaces the band filter, and which is followed by amplifier A_1, while the correcting network ahead of the amplifier is disconnected. Connected in the reception channel, past the demodulator DM, is a correcting network CN with a low-path filter and amplifier A_2. The first two elements perform two functions: they cut off all the frequencies beyond 2.4 kc, and perform partial correction of the speech frequencies. Of the two differential systems of the STDU-35 amplifier, one was left (on the station side), while a new one, described below, is connected on the line side. The telephone channel created in this manner operated with sufficient reliability on a line section 145 km long over a bimetallic circuit without noticeable noise.

After successfully completing the work on organizing the supplementary channel, comrade Lisunov reconstructed the OKS rack in accordance with the circuit under consideration. The block diagram of the reconstructed OKS rack of the B station is shown in Figure 2. Shown in parenthesis in this diagram is the function of each individual unit prior to its reconstruction. The only channel reconstructed was the "null" one, from which two telephone channels A and B were formed.

The differential system of the null channel is used as the differential system of the A channel, and is connected on the station side. Contacts 33, 32, 31, 13, 12, and 11 of the relay R_2 used to send the tonal calling signal and located in the transmission channel between the differential system DS and the transmitting equipment, are all unsoldered and the circuit is straight connected; this disconnects the tonal calling generator TCG. The transmitting equipment and the high frequency amplifier HFA remain entirely unchanged, but a pair of contact springs of relay R_2 are connected inthe supply circuit of the control frequency from the generator Gen. 6.4; these contacts close whenever the call is transmitted. The high frequency differential system (Figure 3) together with the demodulator DM of the reception channel employs 3 line transformers having input and output impedances of 600 ohms. The balance network BN of the differential system is of the single-mesh type; its characteristics were computed without allowing for filters K-5.9 and D-5.9 which are located in the B channel.

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As can be seen from Figure 3, a balance demodulator of the ring type is employed in the reception channel A. A 6.4 kc carrier frequency, arriving from the transmitting equipment, is used for demodulation. Connected past the demodulator in the reception channel is filter D-2.0, removed from the low frequency amplifier. Instead of this filter one can also use D-2.8 filters or the correcting networks from the STDU-35 amplifier, thereby insuring normal width of the channel. The low frequency amplifier LFA in the same channel is taken from the principal null channel. Connected at the output of this amplifier is the tonal calling receiver TCR.

More extensive changes were made in the B channel. The differential system connected in it on the station side is assembled of 2 transformers having 600 ohm input and output impedances, the same as the high frequency differential system. The calling equipment circuit is the same as that in the null channel up to the tonal calling generator TCG. The receiving equipment of the null channel is connected into the transmission channel. This is followed by the HFA amplifier and by the DS differential system with demodulator DM.

Filter D-2.0 is connected in the reception channel past the demodulator. The low frequency amplifier LFA employed is a regulating amplifier which has been somewhat modified first. Connected at its output (Figure 4) is potentiometer R_{21}. The induction coils L_1 and L_2 are disconnected, and the capacitor C_3 in the cathode circuit of tube 6Zh7 is also disconnected, thereby grounding the cathode. The control-frequency relay CFR which is connected in the plate circuit of the tube (past the output transformer) is unsoldered.

Used as the calling receiver CR is a selective amplifier detector (SAD) which has been slightly modified in the circuit of the secondary winding of the output transformer (Figure 5). Connected into this circuit is the removed CFR relay and a cuprox rectifier. When relay RK_4 operates, this completes the circuit to relay R_3 which transmits the call into the switchboard. To reduce the effect of high frequency on the differential system the selective amplifier detector, which serves as a receiver for the call, is connected at the input of D-5.9 filter.

The reconstruction of the OKS rack at the A station differs little from that for the rack in the B station. The principal differential system of the null channel and tonal-calling generator remain connected to channel A. Connected in the transmission loop is the receiving equipment. which serves as a modulator, and the HFA amplifier. The same parts as used in the B-station rack remain in the reception loop, but the SAD is used as the receiver for the call. Both differential systems of the B channel are new. The transmitting equipment and HFA amplifier remain connected in the transmission loop, and the tonal calling receiver is connected in the reception loop at the output of the LFA amplifier (regulating amplifier).

The calls are effected by using the combination system. If the call is transmitted in one direction by the tonal-frequency current, then the call in the opposite direction is by the carrier-frequency of the given channel. The level of the carrier frequency used to transmit the call can be raised to $\pm$ one neper at the output of the K-2.3 filter. This raises the reliability of operation of the calling receiver (SAD). The sensitivity of the latter is regulated by potentiometer R_{19}.

The following levels should be established in both channels: -0.8 nepers in HFL terminal [jack] and from 0 to $\pm$ 0.5 nepers at the output of the K-2.3 filter. When the level is set, a generator with zero level is connected to the output of the HFL.

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Shielded wire or type TRK-1x 2x 0.5 should be used to wire up the reconstructed OKS rack. This will make formation of feedback within the channel and between channels impossible. Additional units and parts are placed in the following manner (at the B station): The high-frequency differential system and the B-channel demodulator are mounted on the rear of the rack on the upper plug between the lead-in terminals and the HFA amplifier; the single-mesh balancing network is also located there. The differential system of the station side of the B channel is mounted on the line and balance-transformer panel. Below, under the HFA amplifier, the high-frequency differential system and the demodulator of the A channel, together with the balancing network of the latter is placed.

To keep the shutdown time of the channel at a minimum during reconstruction, the first work to be performed was the wiring that did not affect the principal null channel. A time was then chosen when stoppage of the channels would not disturb the communication, and the required re-soldering work was done in accordance with the schedule described. With good preparation, not more than 1-2 hours was consumed in re-soldering. The next step is to tune the B channel, which operates at 5.4 kc, followed by tuning of the A channel. Such a sequence is explained by the fact that the B channel is more stable, and in case of necessity can be put into operation without waiting for the final tuning of channel A. In our station it was possible to tune both channels in one night, and to use the following night to improve the operation of the A channel and to plot the characteristics of both channels.

The lower stability of the A channel is due to the more complicated balancing required at its high-frequency output. The noise in the channel is negligible. The generator is synchronised in the usual manner. The OKS racks, reconstructed as described, have been in successful operation for a long time in a copper-circuit section 112 km long. So far there was no opportunity of checking the operation of the racks with steel circuits.

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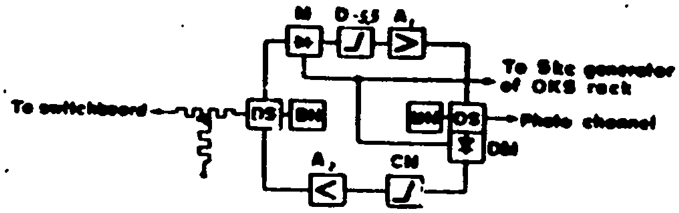

Figure 1

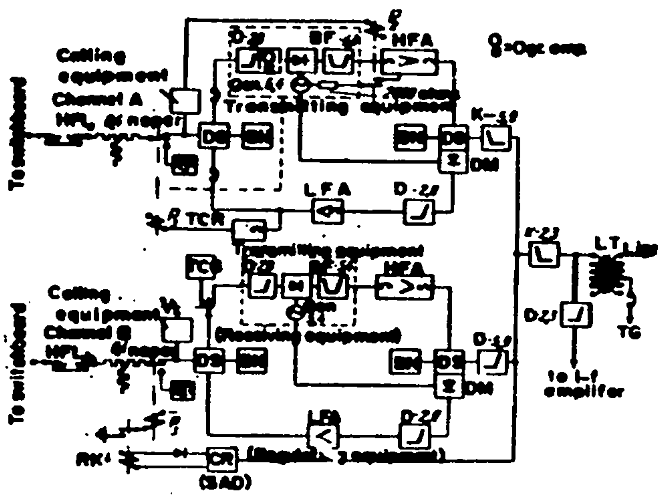

Figure 2

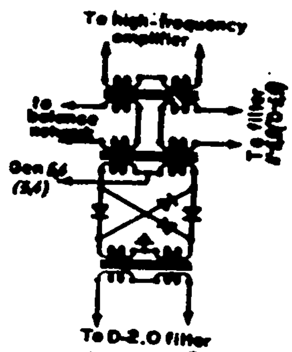

Figure 3

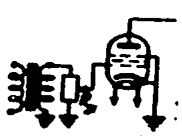

Figure 4

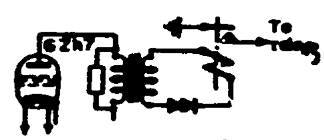

Figure 5

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